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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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PAUL J WHITE, SENIOR COUNSEL
NATIONAL RENEWABLE ENERGY LABORATORY (NREL)
1617 COLE BOULEVARD
GOLDEN, CO 80401-3393

EXAMINER

AFREMOVA, VERA

ART UNIT PAPER NUMBER

1651

DATE MAILED: 07/30/2002 7

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/748,690

Applicant(s)

Melis Anastasios

Examiner

Vera Afremova

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on May 28, 2002
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3, 5-8, and 10 is/are pending in the application.
- 4a) Of the above, claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3, 5-8, and 10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☒ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____ 6) ☐ Other:

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DETAILED ACTION

Claims 1-3, 5-8 and 10 were amended and claims 4 and 9 were canceled by applicants [Paper No. 6 filed 5/28/2002].

Claims 1-3, 5-8 and 10 as amended are under examination in the instant office action.

Priority

It was noted in the prior office action that the applicants' claim for domestic priority based on the provisional application 60/173,391 filed 12/28/1999 (see specification page 1, par. 1) was acknowledged. However, it is not properly claimed because it is not properly indicated in the Oath/Declaration which is present in the contents of the instant file 09/748, 690.

The provisional application 60/214, 380, which is presently indicated in the applicants' oath and declaration, does not appear to be related to the claimed subject matter and to the disclosed subject matter. Appropriate clarification and/or correction to the applicants' declaration was requested in the prior office action.

Oath/Declaration

The oath or declaration remains defective because it claims priority to the wrong application 60/214,380 which is drawn to the subject matter distinct from the instant application.

A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

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Response to Arguments

Applicants' arguments filed 5/28/2002 have been fully considered but they are not persuasive for the reasons below.

Claim Rejections - 35 USC § 112

Claims 1-3, 5-8 and 10 as amended remain rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention for the reasons as explained in the prior office action and for the reasons as explained below.

Claim 1 as amended is rendered indefinite by the phrase "incubating the culture in light to **provide** a rate of light-induced oxygen production equal to or less than a rate of cellular respiration" because it is unclear what condition (element, step) provides for the rates of oxygen production and respiration as intended. The step (d) requires only the "light" condition. And the algal culture, which is a photosynthetic microorganism, is expected to produce oxygen in the light rather than to increase respiration. However, the step(d) fails to indicate what provides for oxygen production rate to be less than respiration rate either in the step (d) or before. Therefore, it is uncertain what other conditions are intended besides "incubating the culture in light". Does the method intend to comprise step of measuring rates of oxygen production and respiration before incubating step?

The claimed method as amended remains indefinite with regard to the phrase "**temporal** separation of oxygen evolution" because it is uncertain when and from what "oxygen evolution"

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is separated. Is it from hydrogen (“hydrogen production”) or from carbon dioxide (“rate of cellular respiration)? Or whether is “separation” achieved by “sealing the culture from atmospheric oxygen” (step c) ? Is it complete separation in time? What are time periods?

The claimed method as amended remains indefinite with regard to step of “depleting a nutrient”. It is unclear whether the nutrient was present in a medium of step (a), whether the nutrient is used (depleted) during microbial grow to a concentration less than 0.5 millimolar (claim 3) or whether the medium is replaced by another medium without the claimed nutrient(s). It is uncertain as claimed whether a depleting step is an active step such as changing a nutrient medium to another medium, for example, or whether a depleting step is an inherent process as the result of growing microorganisms and, thus, using/depleting nutrients in the medium.

Claim 1 remains indefinite and confusing with regard to the use of light energy during the whole process because it is not particularly clear whether or not some differences are intended between “illuminated conditions” in step (a) and “light” condition in step (d).

Claim 5 remains indefinite because it is not particularly clear whether “a plurality of cycles” refers to incubating step (d) only or it refers to steps from (a) to (d) without collecting step (e) or it refers to all steps from (a) to (e). It remains uncertain during what step of the process or when a “temporal” separation of oxygen takes place in the plurality of cycles.

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Claim Rejections - 35 USC § 102

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

The claim rejection under 35 U.S.C. 102(b) as being anticipated by US 4,010,076 [A] has been removed because the amended method requires culturing of a photosynthetic algal microorganism. The cited patent US'076 provides the exemplified disclosure with regard to culturing bacterial cells. However, it suggests the same method for a variety of photosynthetic algal culture. Applicants' argument that the cited patent US 4,010,076 (Weetall) does not teach a depleting step is not found convincing because the method of the cited patent teaches the use of "spent" culture and thus, it teaches the use of a culture system with depleted nutrients for the purpose of "temporal separation" of oxygen evolution and for production of hydrogen as intended for the presently claimed method.

Claims 1-3, 5-8 and 10 as amended remain rejected under 35 U.S.C. 102(b) as being anticipated by US 4,442,211 [IDS-1].

Claims are directed to a process of a temporal separation of oxygen evolution and hydrogen production by photosynthetic algal microorganism wherein the process comprises steps of growing the algal microorganism in a medium under illuminated conditions in order to accumulate endogenous substrate, depleting nutrients including sulfur, iron or manganese from the medium, sealing the microorganism from atmospheric oxygen, incubating the sealed

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microorganism under illuminated conditions and collecting gaseous products. Some claims are further drawn to hydrogen evolution/generation/production from water and accumulated substrate under illuminated conditions. Some claims are further drawn to a repetition of process or to a plurality of cycles. Some claims are further drawn to accumulation of endogenous substrates such as acetate or carbohydrate or proteins. Some claims are further drawn to the use of algal culture such as *Chlamydomonas reinhardtii*.

The cited patent is relied upon as explained in the prior office action and repeated herein.

US 4,442,211 [IDS-1] discloses a process of a “temporal separation of oxygen evolution” and hydrogen production by a photosynthetic algal microorganism such as *Chlamydomonas reinhardtii* wherein the process comprises steps of growing the microorganism in a medium under illuminated conditions in order to accumulate endogenous substrate and, thus, depleting nutrients including sulfur, iron or manganese from the original medium by growing algal cells and by accumulating endogenous substrates. The cited method also comprises step of sealing the microorganism from atmospheric oxygen and/or incubating the microorganism under illuminated conditions or in the light in the environment free from atmospheric oxygen and carbon dioxide by passing inert gas through the culture system. The cited method comprises step of collecting gaseous products including hydrogen (col.1 lines 62-65). The disclosed method teaches hydrogen generation by algal culture of *Chlamydomonas reinhardtii* from water and accumulated substrates under illuminated conditions (col. 1, lines 60-68 and col. 2, lines 1-3). The cited patent also encompasses a repetition of the process steps or a plurality of cycles (col. 3, lines 32-45).

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Although, the cited method is not particularly clear whether sulfur, iron or manganese in the medium were depleted to a particular concentration of 0.5 millimolar or less as required by the presently claimed method, it is reasonably expected that the growing step inherently results in the depletion of these inorganic nutrients particularly in view that the starting or the original culture medium contains these inorganic compounds as "trace elements" or in amounts less than 0.5 millimolar (col. 2, lines 54-55).

Thus, the claimed method is considered to be anticipated by the method of the cited patent because it comprises the same active steps as the claimed method.

Applicants argument is directed to the idea that the cited patent US 4,442,211 (Greenbaum) does not recognize the problem of deactivation of hydrogenase in the presence of oxygen (page 6, par. 3). However, the argument is directed to the mechanism of hydrogen production by algal culture rather than to the differences in the protocols of active steps. Thus, the cited method, which comprises the same steps and structural elements as the claimed method, inherently includes the same mechanism or conditions for hydrogen production or the same "temporal separation of oxygen evolution" and hydrogen production which provides for avoiding a deactivation of hydrogenase as intended and/or argued.

The applicants' arguments as directed to the lack of a step of depleting a particular nutrient in the method of the cited patent are not persuasive because the claimed method does not require active step of changing culture medium but it rather encompasses depleting or using the nutrients by growing the algal cells as explained above.

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The applicants arguments as directed to “incubating the culture in light **to provide** a rate of light-induced oxygen production equal to or less than a rate of cellular respiration” do not appear to have persuasive grounds because the claimed method does not clearly indicate what provides for the rate of oxygen production by a photosynthetic algal culture to be less than the respiration rate.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-3, 5-8 and 10 as amended remain rejected under 35 U.S.C. 103(a) as being unpatentable over US 4,442,211 [IDS-1] taken with US 4,010,076 [A], Wykoff et al. [U] and Melis [IDS-2-1].

Claims are as explained above.

The cited references are relied upon as explained in the prior office action.

US 4,442,211 [IDS-1] is relied upon as explained above. It is silent with regard to a controlled depletion of nutrients and/or controlled induction of a “temporal separation of oxygen evolution” and hydrogen production by algal microorganisms as the result of a controlled nutrient depletion from the culture medium.

The cited reference by Wykoff et al. [U] teaches that decline of oxygen evolution by photosynthetic organisms is induced by nutrient starvation and that the photosynthetic evolution

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of oxygen in a culture of *Chlamydomonas reinhardtii* is induced by sulfur starvation or depletion of sulfur from the culture medium (abstract). In addition, the reference by Melis [IDS-2-1] teaches a temporal separation of microbial oxygen and hydrogen production by applying stress conditions to the microbial culture.

US 4,010,076 [A] is relied upon for the teaching related to the use of various photosynthetic algal cultures including blue, green and red algal cultures for production of hydrogen from water in the “spent” culture or in the media depleted from nutrients.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the claimed invention was made to modify the prior art method of the cited patent US 4,442,211 [IDS-1] by introducing an active step directed to controlling nutrient depletion or sulfur starvation with a reasonable expectation of success in decreasing oxygen production or in temporal separation of oxygen production and hydrogen production because the prior art teaches that nutrient depletion from the culture medium results in the decline of photosynthetic oxygen production as suggested by reference by Wykoff et al. [U] and because hydrogen is produced from water under illuminated conditions by various photometabolically active algal microorganisms as taught by US 4,442,211 [IDS-1] and US 4,010,076 [A]. One of skill in the art would have been motivated to separate oxygen and hydrogen production for the expected benefits of maximizing the production of hydrogen with algal cultures. Thus, the claimed invention as a whole was clearly prima facie obvious, especially in the absence of evidence to the contrary.

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The claimed subject matter fails to patentably distinguish over the state art as represented by the cited references. Therefore, the claims are properly rejected under 35 USC § 103.

With regard to the cited patents US 4,442,211 (Greenbaum), US 4,010,076 (Weetall) and the references by Wykoff et al applicants' main argument is directed to the concept of a mechanism of hydrogen production by algal culture rather than to the differences in the protocols of active steps. However, the cited methods of US 4,442,211 (Greenbaum) and US 4,010,076 (Weetall) comprises the same {US'211} or the similar {US'076} steps and structural elements as the claimed method and, thus, they are reasonably expected to include the same mechanism or conditions for hydrogen production or the same "temporal separation of oxygen evolution" and hydrogen production which provides for avoiding a deactivation of hydrogenase as intended and/or argued. In addition, the reference by Wykoff et al teaches decreasing oxygen production or separating oxygen production by decreasing amounts of nutrients such as sulfur. Therefore, the cited prior art discloses the same process as the applicants' process regardless whether or not the precise mechanism of action is recognized.

The applicants' affidavit filed under 37CFR 1.131 [part of Paper No. 6 filed 5/28/2002] is not proper because all inventors of the subject matter have to sign the affidavit. See MPEP 715.04 (A). When less than all named inventors of an application sign the affidavit, it should be shown that less than all inventors of the application invented the subject matter of the claims under rejection. See MPEP 715.04 (B). However, the applicants' affidavit identifies only five of

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six inventors excluding M. Forestier. But the cited reference which is applied in the claim rejection includes M. Forestier but it excludes J. Benemann. Thus, the contents of affidavit are confusing with regard to all named inventors of the instant application and of the cited reference by Melis et al. [IDS-2-1]. Therefore, the applicants' affidavit filed under 37CFR 1.131 is not acceptable and the reference by Melis et al. [IDS-2-1] is properly applied in the claim rejection under 35 U.S.C. 103(a).

No claims are allowed.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vera Afremova whose telephone number is (703) 308-9351. The examiner can normally be reached on Monday to Friday from 9:00 to 5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Wityshyn, can be reached on (703) 308-4743. The fax phone number for this Group is (703) 308-4242.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0196.

Vera Afremova

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July 24, 2002.



IRENE MARY
PRIMARY EXAMINER